The Planetary Data System Web Catalog Interface
Another Use of the Planetary Data System Data Model

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ABSTRACT

The Planetary Data System (PDS) Data Model was presented at the Twelfth IEEE Symposium on Mass Storage Systems. 'l'his data model is used to represent the meta-data that describes entities within the planetary Science Community such as data sets, spacecraft, and targets, as well as the archive data products produced by t-he PDS such as images, spectrum, series, and qubes.

This paper will describe a new use for the PDS Data Model, that of a source for generating Hypertext Markup Language (HTML) documents for access through World Wide Web (WWW) clients such as NCSA's Mosaic. The PDS data set catalog, CD-ROM jukebox volume inventories, and the Planetary Science Data Dictionary are now represented in HTML and have been put online for access through the Internet. The number of users of the PDS data set catalog and orders for planetary science data have increased dramatically. In addition new users in the educational community at both the high school and university levels have been added.

INTRODUCTION

The PDS data model consists of a set of standardized descriptions of entities within the Planetary Science Community. These entities can be real entities in the space exploration domain such as spacecraft, instruments, and targets; conceptual entities such as data sets, archive volumes, and data dictionaries; or the archive data products produced by the PDS such as individual images, spectrum, series, and qubes.

In the PDS, the standardized descriptions are written in the Object Description Language (ODL), an object based language that allows the class and attributes of the entity to be specified. These standardized descriptions, called labels, are written to ASCII files that may be read by users, modified by simple editors, and parsed by PDS supplied library routines.

In the PDS, ODL labels have proven to be very versatile. They have been included as documentation on archive CD-ROM volumes, used to load online database catalogs, and also to represent data dictionary information for stand alone tools. Since ODL labels are in ASCII format, the ODL labels have also been easily transported between the various types of machines within the community.

With the advent of the World Wide Web (WWW) on the internet, it was soon apparent that the PDS would be better able to meet the needs

(NASA) planetary science community. It is a distributed data system consisting of a central node, seven loosely-coupled science discipline nodes, and the National Space Science Data Center (NSSDC). The central node is primarily responsible for the overall management of the nodes, the development of science data product standards, the research of data distribution technology, and the maintenance of a science data set catalog. An example of a data set in the PDS archive is the collection of nearly 50,000 Mars images returned by the two Viking spacecraft.

Science discipline nodes manage science data specific to their science discipline and are responsible for providing scientific expertise, maintaining a local inventory of science data, and developing data product catalogs. Science discipline nodes include the Geoscience, Planetary Plasma Interactions (PPI), Atmospheres, Small Bodies, Rings, Imaging, and the Navigation Ancillary Information Facility (NAIF) node. Data products are individual entities within a data set. For example, a single image within the Viking Mars Image data set is a data product. For a more thorough description of the **PDS see [6].**

What is Science Metadata?

> "Science metadata has been defined as the data about Science data that encapsulates information such as: who did what and when, device character sties, transform definition, documentation and citations, and structure [1]."
>
> "It is imperative that the metadata remain attached to the data or the data become meaningless and unusable [1]."

The PDS requires that all science data sets submitted for inclusion in the archive be accompanied by a standardized collection of science metadata. This science metadata includes labels for the individual data products, a description of the data set, and descriptions of the planetary science entities associated with the data set. This science metadata must. be represented using the ODI, language.

Science data product labels supply both structural and catalog information for the individual products that form a data set. Structural information includes that information that would be useful for manipulating the data product. For example, Viking Mars images are labeled with structural attributes such as the number of lines, line samples, and sample type for each camera image. Catalog information includes the information that. would be useful for finding or understanding the data product. For example, catalog information for a Viking image consists. of 47 attributes including image identifier, image time, and camera filter number.

Labels that describe data sets and associated planetary science entities are generally considered high level catalog information. High level catalog information is useful for understanding the data set and associated entities as well as for finding the data sets. For example, the Viking Mars image data set has attributes such as data set_id, data_set_name, and producer_full name. These attributes supply useful information about the dat–a set and are used for identification. Also included as attributes are textual descriptions such as data_set_desc. The Viking data set has several pages of ASCII text describing the nature of the data set. Other attributes supply explicit links to associated entities. For example, the Viking data set is associated with the target MARS, both VIKING spacecraft, two cameras, the VIKING mission, and an object type of IMAGE. These attributes are especially useful for searching. Catalog information also includes bibliographic references for journal articles and other papers considered useful for understanding the science data.

All science data sets and associated science metadata submitted for inclusion in the archive are reviewed by a committee of peer scientists and PDS science and data engineering staff. After approval and production of the data product volume, an online catalog is loaded to make the data set available for ordering.

What is the ODL Language?

The PDS uses the Object Description Language (ODL) , a simple human readable language with "keyword = value" (keyword/value) statements to describe all entities in the planetary science community. For a more thorough description of ODL see [2]. For example, a data set derived from the Viking image data set is described by the following ODL statements.

```
OBJECT                              = DATA_SET
  DATA_SET_ID                       = "VO1/VO2-M-VIS-5-DIM-V1.0"

  OBJECT                            = DATA_SET_INFORMATION
    ...
    DATA_OBJECT_TYPE                = IMAGE
    DATA_SET_RELEASE_DATE           = 1991
    PROCESSING_LEVEL_ID             = 5
    PRODUCER_FULL_NAME              = "ERIC ELIASON"
    PRODUCER_INSTITUTION_NAME = "UNITED STATES GEOLOGICAL SURVEY"
    ...
    DATA_SET_DESC == "This digital image map of Mars is a
                       cartographic . . ."
    CONFIDENCE_LEVEL_NOTE = ". . . All of the corrections made . . ."
  END_OBJECT

  OBJECT                            = DATA_SET_TARGET
    TARGET_NAME                     =   MARS
  END_OBJECT

  OBJECT                            = SPACECRAFT_DATA_SET
    INSTRUMENT_HOST_ID              = VO1
    INSTRUMENT_ID                   = VISA
```

```
END_OBJECT

OBJECT                              = SPACECRAFT DATA SET
  INSTRUMENT HOST_ID                = Vo 2
  INSTRUMENT_ID                     · VISB
END_ OBJECT

OBJECT                              = DATA_SET_REFERENCE_INFO
  REFERENCE_KEY_ID                  = BATSON1987
  OBJECT                            = REFERENCE
    DOCUMENT  TOPIC_  TYPE          = "IMAGE . . . "
    JOURNAL_NAME                    = "PHOTOGRAMMETRIC . . ."
    PUBLICATION DATE                = "198"/-09-01"
    REFERENCE_DESC ==
   "Batson, R. M. ,  Digital  Cartography  of  the planets:  New
   methods, its status, and future, Photogr. Eng. Remote Sens. ,
   53,  1211-1218,  1987."
    OBJECT                          = REFERENCE_AUTHORS
      AUTHOR FULL NAME              = "R. M.  BATSON"
    END_ OBJECT
           . . .
```

Figure 1. Data Set Label

The use of ODL is extensive throughout the PDS. For example, a complete ODL description of a Planetary Science entity such as the data set above is included as a catalog component on the data set's archive CD-ROM volume set. This same description is also used to load a relational data set catalog. In addition, the individual product labels are included on the archive volume. The attribute values from all the product labels are also extracted and accumulated in a table and placed on the volume. 'l'his table allows for the easy creation of product inventories. The proliferation of keywords is controlled by including all PDS keywords in the Planetary Science Data Dictionary (PSDD) . [3]

The PDS Data Model and Relational Databases

As mentioned earlier, ODL labels are often used to describe data sets and other entities in the Planetary science community. Originally, during the development of the first version of the PDS catalog, these ODL labels were called catalog templates and were used for the specific purpose of collecting the science metadata for loading into a relational data set catalog. As can be seen from figure 1, a data set is represented as a hierarchy of objects. At the top of the hierarchy is the DATA_SET object. This object in turn consists of several subobjects including the DATA_SET_INFORMATION, DATA_SET TARGET, and DATA_SET REFERENCE_INFO. Associated with each of these-objects is a list of keywords that supply the attributes for that object. For example, DATA_SET_ID supplies the identifier for the DATA_SET object. The keyword DATA OBJECT_TYPE in the DATA_SET_INFORMATION objects indicates that the data is of the type IMAGE. TARGETN AME in the DATA__SET___TARGET object indicates the target body of the data set and supplies an explicit link to a specific TARGET object.

To accomplish the loading of the metadata into the catalog database, a program was written to parse the ODL statements and map the hierarchical structure of the ODL label to the relational schema of the catalog database. Essentially each ODL object either represents an entity table or a relationship p table in the relational schema. For example, the information in the DATA_SET_INFORMATION subobject is mapped to the data set information table in the relational schema. This table contains the general information about data sets. The information in the DATA_SET_TARGET table however, is used to load the data set target. This table represents a many-to-many relationship between the data set and target entities. (i.e., A data set can be associated with many targets, and a target can be associated with many data sets.) Finally, there is a need to inherit values between objects. For example, the keyword DATA_SET_ID is inherit-ccl from the DATA_SET object by all subobjects in order that. it may be used as a key in a relational table.

The PDS Data Model. and Product Data Labeling

Contain ?

The primary use of ODL is for the labeling of science data products. PDS requires that each identifiable component or "data product" of a science data set be labeled with keyword/value pairs that descriptive information about the product. For example, each image within a particular image data set, the MARS Digital Image Model (MDIM) data set, is labeled with an IMAGE object that supplies structural information. This is illustrated in Figure 2.

```
OBJECT                         = IMAGE
     LINES                     = 640
     LINE_SAMPLES              = 1008
     SAMPLE_TYPE               = UNSIGNED_INTEGER
     SAMPLE_BITS               = 8
     SAMPLE_BIT_MASK           = 2#11111111#
     CHECKSUM                  = 12345678
END_OBJECT                     = IMAGE
```

Figure 2. MDIM IMAGE Object

This structural information, as mentioned earlier is information that is required for manipulating the actual data product. The combination of the ODL IMAGE object (label) and the actual image data is called an IMAGE data object.

The IMAGE object can additionally be associated with another object that supplies product level catalog information. For example, Figure 3 illustrates the IMAGE MAP PRCJJECTION object for the image in Figure 2.

```
OBJECT                                   == IMAGE MAP PROJECTION
    'DATA SET MAP PROJECTION              ,· "DSMAPDIM.LBL"
    MAP_PROJECTION_TYPE                   = SINUSOIDAL
    MAP_RESOLUTION                        = 256 <PIXEL/DEG>
    MAP_SCALE                             = (1.00390625 <KM/PIXEL>
    MAXIMUM LATITUDE                      = 90.00000
    MINIMUM LATITUDE                      =' 87.50000
    MAXIMUM-LONGITUDE                     = 380.00000
    MINIMUM--LONGITUDE                    = 89.73051
    X AXIS PROJECTION OFFSET              = -23039.975
    Y AXIS "PROJECTION OFFSET             = -502.488
    A_AXIS_RADIUS                         = 3393.4
    B_AXIS_RADIUS                         = 3393.4
    C_AXIS_RADIUS                         = 3375.7
    FIRST_STANDARD_ PARALLEL              ' = "N A"
    SECOND_STANDARD_ PARALLEL             = IIN/All
    POSITIVE_ LONGITUDE_ DIRECTION        = WEST
    CENTER_ LATITUDE                      = ().0
    CENTER_LONGITUDE                      = 335.00000
    REFERENCE_ LATITUDE                   = "N A"
    REFERENCE LONGITUDE                   = ItN/All
    X AXIS FIRST PIXEL                    = 1
    Y AXIS FIRST PIXEL                    = 1
    X_AXIS_LAST_PIXEL                     = 640
    Y_AXIS_LAST_PIXEL                     = 3008
    MAP_PROJECTION_ROTATION               . IIN/All
END OBJECT                               = IMAGE..MAP PROJECTION
```

Figure 3. MDIM IMAGE_MAP_PROJECTION Object

This catalog information specifies that the image is actually one image of a mosaicked MARS map and supplies the information useful for locating and manipulating this image as a part of the map.

The primary purpose of data product labels is to be included with science data on any PDS archive volume. The intent is to supply current and future users with as much of the known information about the data as possible. Scientists in particular want all processing that has occurred on a data product before they start their own research. Much has been written on the uselessness of science data on magnetic tapes without accompanying descriptive material.

In addition to the archive purpose, the data product labels also allow tools to be built that allow simple manipulation of the data and the building of catalogs. Both the PDS and the user community continue to develop tools that take advantage of the descriptive information in PDS data product labels.

THE PDS MODEL AS AN UNDERLYING MODEL FOR A WWW INTERFACE

DARE Inherits from PDS

Within the same JPI, Section, another archiving project, Data Archive and Retrieval Enhancement (DARE) , was established by the Defense Nuclear Agency (DNA). This new project's objective was to develop a state-of-the-art information system to preserve and facilitate the utilization of data generated in nuclear weapons effects (NWE) tests as well as simulation experiments. [7] DARE would include the following categories of information:

- A Directory of DNA Data Holdings
- A Guide to Nuclear Weapons Effects Testing
- Data Inventories
  - Photos
  - Documents
  - Diagrams
  - Waveforms
- A Data Dictionary

DARE was to be implemented in 4 incremental and successively advanced deliveries, each delivery designed and implemented using the Rapid Prototyping Method [8]. 'rhe first delivery was due 8 months from project start. This short implementation time dictated that DARE would need to adopt standards and practices already in use. Although DARE's data domain was completely different from that of the Planetary Data System, the goals and objectives were the same. DARE's Project Management was counting on the team's past. experience and knowledge of PDS standards to leverage DARE's design and ultimate implementation.

The Underlying Model

Resources to purchase and integrate a Database Management System (DBMS) would not be available in the first delivery. DARE would need to adopt a model that would satisfy the following requirements:

1) Would be simple to learn, use, and implement
2) Could be described in a data dictionary
3) Could be validated
4) Could point to actual data
5) Could be searched easily without a DBMS
6) Could be easily parsed and manipulated
7) Could be easily translatable into a DBMS later

The ODL labeling standard used by PDS satisfied all requirements, and the DARE team had experience with ODL labels and understood the PDS standard. DARE's initial database, then, would be implemented as individual ODL labels.

Searching and Accessing ODL Labels

A World Wide Web server, available only to the DNA community, would provide access to the DARE archive. Introductory material, descriptions of the nuclear weapons effects domain, and menus guiding the user to various data inventories would be provided as HTML documents. The capability to search and access ODL labels via the WWW would need to be designed and implemented.

DARE's search engine for the first delivery would need to meet the following requirements:

1) Would be cost-effective (basically, free)
2) Would be fast
3) Would be easy to use and implement
4) Would provide full-text weighted searches of ODL labels
5) Could easily be integrated with the World Wide Web

The WAIS (Wide Area Information Servers) search engine satisfied these requirements, and the DARE team had experience since PDS had used WAIS to provide an Internet-accessible full-text search capability for its data supplier documents. DARE adopted WAIS as its full-text engine, and would build a gateway between the WWW server and the WAIS search engine.

Building on the Concepts

Providing Keyword/Value Menus

Since the ODL format was easily parsable and the standard well understood, DARE decided it could provide an additional method for locating data items. When ODL labels, and their associated data, were added to the system, a preparation step would parse the labels and organize the keywords and values into HTML documents. These documents could then be used to lead users to particular labels based on those keywords and values. For instance, if a user were searching for items in the Photo Inventory, they could choose to find photos by such keywords as COLOR TYPE or DATE. If they chose COLOR TYPE, they might be able to choo-se between "Color" and "Black and White." If they chose DATE, they could find photos identified by a certain date.

DARE users would have two search methods for finding labels: full-text, and keyword/value.

"Tagging" the Labels

Once a user found an ODL label describing a data item of interest, either by full-text search or via the keyword/value menus, what then? What would the DARE software display? The raw keyword = value label? The actual data represented by the label? What if DARE only had the label.?

The DARE team felt that simply displaying the raw ASCII label was not sufficient. Since ODL was easily parsable, they felt they could dynamically tag the information in HTML to provide hypertext links to supporting information. The keywords in the label could be linked to the data dictionary. The values in the label could be linked the Nuclear Weapons Effects descriptions in the Guide. The user should not have to "back out." and follow a different path when the information was directly related.

After a series of iterations on these ideas, the design called for two representations of the label to be available to the user.

1) A nice layout of the label information, displaying the label's title, its description, and keyword values that would provide hypertext links to the Guide. Also, the user would have the choice of viewing the on-line data, if available, or viewing the other version of the label (see 2).

2) A keyword = value format with each keyword linked to its data dictionary description.

The Resulting DARE Software

The first incremental delivery of the DARE software included more functionality than was originally promised, and produced a software product that could be applied to any model. of ODL labels. Since data inventories and the underlying model could change over time, the scripts had been written to use tailorable configuration files.

Figure 4 illustrates how the first incremental delivery of DARE software resulted in three main subsystems:

Confiqure -	Prepares the DARE software environment using configuration files to identify data inventories and supporting information.
Setup	Creates the static keyword/value HTML pages, WAIS indexes, and Perl arrays needed for runtime execution.
Runtime	Executes and summarizes, WAIS searches, displays information about a single inventory or supporting information item, and dynamically tags both versions of the displayed label.

PDS Inherits from DARE

The pendulum was ready to swing hack in the other direction. DARE had used the PDS model of ODL labels to describe its data as well as its data dictionary. Now PDS could use DARE's software to provide a WWW interface to its own model of ODL labels.

Figure 5 illustrates the process of extracting meta-data and data dictionary information from the PDS relational database into ODL labels and setting up a WWW interface to those labels using the DARE software. Labels were also extracted from actual CD-ROM volumes, never before accessible or searchable by any on-line means, and added them to the label inventories. Configuration files were tailored to process particular PDS sets of information and to process particular keywords. The labels from the catalog, data dictionary, and CD-ROM volumes were then processed by the DARE software.

Figure 6 illustrates the resulting PDS Catalog WWW interface. Instead of DARE-specific data inventories, the Full-Text Summary displays the PDS-specific data inventories and catalog categories:

Data Sets
Data Set Collections
Volumes
Missions
Instrument Hosts
Instruments
Targets

Keyword/value pages displayed PDS-specific keywords such as Mission Name, Target Name, Data Set Name, etc. Label layout pages now described PDS entities and provided links to other PDS entities. Orderable items, such as Data Sets, Data Set Collections, and Volumes displayed an order form to the user. The tagged label provided links to the PDS data dictionary.

Changes to the PDS Model

Some changes to the PDS model had to be made to be processed correctly by the DARE software. These included:

Subobjects

DARE did not implement the concept of subobjects. For instance, in Figure 1, the DATA SET label. contains a subobject for DATA_SET_"TARGET. To--indicate that the Data Set was related to more than one target, the subobject of DATA_SET_TARGET would have to be repeated, as is the SPACECRAFT_DATA_SET subobject. To make this information directly processable by DARE, the label needed to be changed to use a list of values f'or the keyword instead.

TARGET_ NAME = {MARS, VENUS}

Multiple Keys

The DARE software did not provide for multiple keys into an entity. Looking at Figure 1 again, an Instrument is identified by both the INSTRUMENT HOST ID and the INSTRUMENT ID. To make this work wit-h–the DARE software, a single unique name was assigned to each instrument. Thus , the keyword became INSTRUMENT NAME and the value became a list:

INSTRUMENT_NAME = {"Voyager 1 Visual Imaging Subsystem",
"Voyager 2 Visual Imaging Subsystem")

Since the schema was well understood and the information still fit into standard ODL labels, the translation was easily accomplished. (Work is currently in progress to streamline the PDS Model, as we will discuss later in this paper, and the streamlined model will have very few subobjects to translate.)

Changes to the DARE Software

PDS immediately made enhancements to their implementation of the DARE software, some of which have already been incorporated into DARE's own implementation. Some of these enhancements are:

- Keywords to be tagged as URL (Uniform Resource Locator) keywords were defined in a new configuration file. When the nice layout of the label is rendered, the values of these keywords are tagged automatically as links, using the keyword itself as the link text.
- Taking advantage of HTML's set of form tags, an order form appears at the bottom of every rendered label, using the information defined in the label to display ordering options.
- Users can submit comments about the catalog interface by filling out a static comments form.
- The rendered label can provide hypertext links to other categories of information, such as Data Sets, Targets, Missions, etc. Currently, DARE only provides links to its Guide, or domain descriptions.

The WWW PDS Catalog Functionality

The World Wide Web implementation of the PDS Data Set Catalog is now available. It provides information about the planetary science data available from PDS. Users can search descriptions of planetary missions, instrument hosts, instruments, targets, data sets, data set collections, and CD-ROM volumes to locate and order data of interest.

The PDS Data Set Catalog and archive is composed of several data categories. These categories have been color-coded to help users keep track of which data category is currently being viewed. Each catalog entry is described by a label containing keyword = value statements. These labels are used to group the information into various menu-like lists and full-text indexes which users may use to locate information of interest. Currently, these include the following categories:

Orderable PDS Data: Users may place orders for planetary data organized by:

Data Sets
Data Set Collections
CD-ROM Volumes

Guide to Planetary Exploration: Users may read information about planetary exploration described in the catalog. . Information is available about:

Missions
Targets
Instrument Hosts
Instruments

Supporting Information: When viewing information from the data categories, links are provided to supporting information. This information includes:

Reference Citations
Data Dictionary Descriptions

Searching

Users may conduct a full-text search of a specific data category, or all data categories. Searching all categories is a good way for new PDS Data Set Catalog users to search for data of interest. Although PDS meta-data is described using a keyword = value "label," users do not need to know the precise names of those keywords or their possible values. Conducting a full-text search will match search words, whether they are values of specific keywords or are present in descriptive text, in all labels for all categories.

Each data category presents a "search page" to the user. This search page tells the user how many titles are available in that category and then provides them with three methods to find titles of interest.

Viewing a list of titles, such as Data Set Names

The titles will be listed alphabetically, with a maximum of 100 titles per page. If there are more than 100 titles available, you may view the next page by selecting the provided link.

Viewing titles grouped by keywords, such as Mission Name

Titles for each data category have been organized by certain keywords found within the labels. Some of these include:

Data Object Type
Data Set Id
Instrument Name
...

Selecting a keyword, such as "Instrument Name" will display a list of values for that keyword.

24-COLOR SURVEY DUAL BEAM PHOTOMETER
ARECIBO 0BSERVAT0R% RADIO TELESCOPE
FIELD EXPERIMENT DAEDALUS SPECTROMETER
FIELD EXPERIMENT FIELD PORTABLE ANEMOMETER MASTS
...

Selecting a value for that. keyword, such as "ARECIBO OBSERVATORY RADIO TELESCOPE" will position the user in a list of titles grouped by keyword values. From here, users can select a title and view the label information.

Conducting a full-text search

A WAIS source, or index, is created for every PDS category to. allow users to conduct full-text searches. Users may use search words **such as** "mars mosaic" and they will be presented with a list of titles within that data category that matched their query. These "hits" are ranked by how well they matched the query. From this resulting list, users can select a title and view the label information.

Viewing Catalog Information

Once a title is selected, its catalog information is presented.

Title.

Description.

Related Information: Supporting or related information may be available, such as Instrument Host, Instrument., etc., as well as the underlying label containing link to the data dictionary.

In Figure 6, the keyword TARGET_NAME on the Tagged Label page would link to its description in the data dictionary, and the word VENUS on the Layout HTML page would be linked to the Guide's Target description of VENUS.

Order Form: For orderable items (Data Sets, Data Set Collections, CD-ROM Volumes) , users may fill out the Order Form displayed at the bottom of the page.

Ordering Data

Simple fill-out forms are provided for submitting orders to PDS. These forms are displayed at the bottom of the page when viewing catalog information about an orderable item.

Planned Enhancements

The Model

A primary requirement in the development of Version 1.0 of the PDS catalog was that there be sufficient science meta-data to support the search for data to enable correlative science. This resulted in complex models for most of the entities. For example, the instrument model included complex relationships between instrument modes, measured parameters, and physical components of the instrument. These complex relationships allowed for very sophisticated queries where a scientist could identify data using almost any attribute of the data, the instrument that produced it, or the spacecraft that carried it.

It soon became apparent however that the effort involved in collecting and maintaining the data for this complex model was not worth the benefit gained. In fact, later surveys found that few of the scientists in the community now felt that the meta-data should support correlative searches. There was much more interest in meta-data that supplied detailed processing information, much of which was lost when trying to fit the data into a fixed model. The focus quickly evolved to supplying better textual descriptions and providing references to existing material such as science articles and instrument design documents.

As a result, the PDS is currently in the process of implementing a streamlined model for many of the catalog entities such as data set and instrument. The original conceptual model still exists, but where keywords and subobjects had predominated in Version 1.0, structured textual descriptions with paragraph headings are now the norm.

Alternately, the data model as used for data product labeling has been enthusiastically accepted by the Planetary Science Community. With this acceptance there arises the need to meet new requirements. In particular, new data products are now being produced that do not share t-he characteristics of any of the earlier PDS objects. For example, where simple images were sufficient for the Viking and Voyager mission, new missions **might** require banded interleaved images. Subsequently there is a continuing effort to develop extensions to ODL and to allow more generic structures for data products.

The Software

Both DARE and PDS are hoping to benefit from a new version of the WAIS engine called Structured Fields WAIS, a product of the University of Dortmund. This product allows the definition of fields within documents to be indexed and searched separately. The ODI, keyword = value labels have a perfect format for this type of indexing. This would allow such searches as "target=venus and object=image" to be executed. The words "venus" and "image" would need to be values of those keywords in order to match the query, rather than being located anywhere within the text. This type of structured search would be made available as another searching option with an HTML form interface.

It is expected that PDS Discipline Nodes may require a linking mechanism from their own WWW servers to the PDS Data Set Catalog WWW server. These servers at the remote Nodes might be similar catalog systems, or standard HTML documents containing hypertext 1 inks. A mechanism, or Perl script, could easily be put in place to accept requests and respond with the rendered label describing the catalog or data dictionary information.

It is also expected that direct access between orderable items and the actual data can be implemented. Jukeboxes containing almost every planetary CD-ROM ~~is~~ are currently on-line. A mechanism to connect the catalog's data set descriptions with the actual on-line data is not far away.

SUMMARY

The PDS data model grew out of the need to supply information about science data in an easy-to-read format. The simple requirement was that any scientist receiving data from the PDS should be able to become familiar with the data using almost any commonly available hardware platform and the simplest of tools.

The resultant Object Description Language, the Planetary Science data dictionary, and a standardized object-based method for describing entities has been enthusiastically accepted by the Planetary Science community. To date over nnn (TBD) CD-ROMs, representing nnn terrabytes of data have been produced using these standards and have been made available to the community.

The advent of the World Wide Web has given the PDS the means to simplify access to Planetary Science data. The net is available to most. of the Planetary Science community, WWW client software is readily available for most hardware platforms, interface development is relatively easy, and a more common look-and-feel is presented to the users. In addition, the translation of the PDS data model from ODL ASCII labels to the WWW HyperText Markup Language (HTML) has proven to be very easy. Using WWW, the PDS continues to make its resources more available to its primary customers and expects to gain many more new users via the internet.

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